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Concentric Cell Improvements

- Direct TCH Allocation on Concentric Cell (TF889)
  - The feature allows a direct TCH allocation in the inner zone of a concentric cell thereby avoiding a handover from the outer zone to inner zone. This applies for both call setup and HO
  - Criteria for Direct TCH Allocation
    - RxLevDL + BS_Pwr_Att > concentAlgoExtRxLev
    - MS_BS_Dist < concentAlgoExtMsRange (timing advance criterion)
  - Criteria for HandOver into Inner Zone
    - rxLevNCell(n) – [rxLevMinCell(n) + Max {0, msTxPwrMaxCell(n) – MSTxPwrMaxCell(n)} + biZonePowerOffset(n)] > 0 AND
    - rxLevNCell(n) > RxLev + PBGT
  - The feature reduces the BSC load and the ABIS signaling traffic
  - Supported on BTSs equipped with DRXs or DCU4s
- Frequency Reuse on both zones of a Concentric Cell (CM888)
  - This feature allows the use of the same frequencies on the inner and outer zones of concentric cells (the two zones used separate frequency sets prior to V12)

NORTEL NETWORKS

Concentric Cell: Direct TCH allocations

Principles :

- Concentric cells have been introduced in V9 and V12 provides major improvements for the feature
- Use the same pool of frequencies on both zones for SFH (system limitation before)
- Allocate directly a TCH in the small zone during call set-up or HO
  - Go directly from large zone to small zone during call set-up (SDCCH of large zone → TCH of small zone)
  - Direct HO from a normal cell to the small zone of an adjacent concentric cell
  - Direct HO from small zone of a concentric cell to small of an adjacent concentric cell

Intercell HO Normal → small zone

Intercell HO small zone → small zone

Definitions

- This feature is applicable to concentric cells, dualzone cells, dualcoupling cells and dualband cells (dualcells)
- Band 0: large zone that carries the BCCH frequency
- Band 1: small zone that carries the TCH channels
- Concentric cell : 2 pools of resources (TDMAs) are defined using RxLev and optionally Timing Advance as allocation criteria. Some TRXs are configured to transmit at different power resulting in 2 different coverage areas
- Dualcoupling cell : the TRXs are not combined with the same type of combiner and thus have different coupling loss resulting in 2 different coverage areas
- Dualcell : GSM900 and 1800 TRXs coexist and share the same BCCH. The propagation loss being different, it results in 2 different coverage areas

NORTEL NETWORKS

Concentric Cell: Direct TCH allocations

Principles (1/2)

- For Call set-up (SDCCH => TCH)
  - If RxLevDL + BS_PwrAtt > concentAlgoExtRxLev and MS_BS_dist < concentAlgoExtMsrange => the BTS answers positively and the BSC will allocate a TCH in the small zone
- For intercell HO
  - The direct TCH allocation during HO is only allowed for an intra BSS HO
  - The timing advance in the new cell is unknown => the distance criteria is not used
  - Selection of the eligible cell :
    - **EXP1** = RxLevNCell(n) - [RxLevMinCell(n) + Max(0 , msTxPwrMaxCell(n) - MSTxPwrMax) > **0**
  - Calculation of the PBGT in the outer zone for each adjacent cell reported. This calculation depends on the zone of the serving cell => 2 cases, inner and outer
    - MS in the outer zone
    - **PBGT** = RxLevNCell(n) - RxLevDL - (bsTxPwrMax - bsCurrentTxPwr) + Min(msTxPwrMax - MSTxPwr)
    - MS in the inner zone
    - **PBGT** = RxLevNCell(n) - [RxLevDL(Band1) + bizonePowerOffset] - (bsTxPwrMax - bsCurrentTxPwr) + Min(msTxPwrMax(2ndband) , MSTxPwr) + Min(msTxPwrMaxCell(n) , MSTxPwr)
  - Declaration of the 6 best cells as preferred cells for HO
    - **EXP2** = PBGT - hoMargin_XX(n) > **0**

Concentric Cell: Direct TCH allocations

Principles (2/2)

- L1M determines whether the call can be directed to the innerzone
  - **EXP3** = RxLevNCell(n) - [rxLevMinCell(n) + bizonePowerOffset + Max(0 , msTxPwrMax(n) - MSTxPwrMax)] > **0**
  - bizonePowerOffset = power offset difference between the inner and the outer TRX of the adjacent cell n
- If EXP3 is not > 0 the HO is done into the outer zone since the list of preferred cells was made on a outer zone basis (up to EXP2)

Parameters

Parameter	Object	NMO recommended value
biZonePowerOffset	adjacentCellHandOver	
biZonePowerOffset	handOverControl	
concentAlgoIntRxLev	handOverControl	< -110 dBm
concentAlgoExtRxLev	handOverControl	-95 dBm
concentAlgoIntMsRange	handOverControl	
standardIndicator	bts	gsmdcs or dcsgsm
concentric cell	bts	concentric or dualband (for direct TCH alloc. to band 1 of a dualcell)

Counters

- assignToOtherBandOrZone (C1799) : located in the cell, it gives the number of directed allocation of a TCH in the innerzone of a concentric cell. The triggering event is the reception of an Assign_Complete message on TCH from the MS

Limitations

- The direct handover to small zone is only allowed for intra BSC handover. The distance criteria is not used (it is the level)

Concentric Cell: Direct TCH allocations

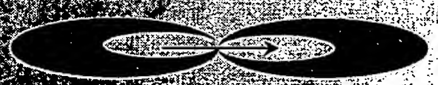
Improvements:

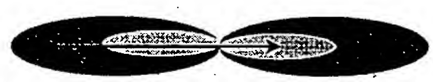
- No going through the outer zone to go into the inner zone => less signalling on Abis I/F for intra BSC HO. The BSC is more available for call establishment, more resources are available in the outer zone to welcome new calls
- Avoids subsequent intracell HO => reduces the risk of BSC overload and improves the voice quality
- Reduction of the blocking rate in the large zone
- Communication cut duration is shorter since intracell HO is replaced by an assignment => better call quality
- Better traffic repartition between zones and it solves the large zone congestion problems
- Allows to use the same frequency set per cell in order to benefit of the SFH. This feature allows to increase the hopping gain by using only one set of frequencies per cell. In the small zone, the fractional load can be higher since there is little overlap with the neighbours

Miscalleneous

- The tuning of *bizonePowerOffset* depends partially on the objectives of the client. For a concentric cell, it depends on the ratio of the surfaces; for a dualcoupling cell, it depends on the difference of the losses due to different couplings. Finally, in a dualband network, it is estimated at 6 to 8 dB to take the propagation losses into consideration
- Optimise *concentAlgoXX* in order to determine the percentage of traffic that needs to go into the small zone by observing the counters
- This feature is now very interesting and should be experimented as soon as possible

Concentric Cell: Direct TCH allocations





Dualband cell

- Intercell intraband HO: band1 --> band1
  1_ EXP1 > 0
  2_ PBGT (msTxPwrMax2ndBand, bizonePowerOffset)
  3_ EXP2 > 0
  4_ EXP3 (bizonePowerOffset(n)) > 0
  5_ MS_Band_supported(standardIndicatorBand1) is true

- Intercell interband HO: band0 --> band1
  1_ EXP1 > 0
  2_ PBGT (msTxPwrMax)
  3_ EXP2 > 0
  4_ EXP3 (bizonePowerOffset(n)) > 0
  5_ MS_Band_supported(standardIndicatorBand1) is true

Concentric cell/ Dualcoupling cell

- Intercell intrazone HO: small --> small
  1_ EXP1 > 0
  2_ PBGT (msTxPwrMax, bizonePowerOffset)
  3_ EXP2 > 0
  4_ EXP3 (bizonePowerOffset(n)) > 0

- Intercell interzone HO: large --> small
  1_ EXP1 > 0
  2_ PBGT (msTxPwrMax)
  3_ EXP2 > 0
  4_ EXP3 (bizonePowerOffset(n)) > 0

Concentric Cell: Direct TCH allocations

Feature:

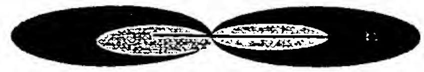
- Interzone HO: small --> large:
  rxLevDL+BS_Pwr_Att < concentAlgoIntRxLev

- Interzone HO: large --> small:
  rxLevDL+BS_Pwr_Att > concentAlgoExtRxLev

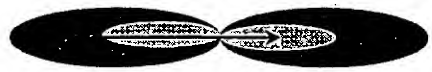
- Intracell intraband HO: large --> large
  or small --> small
  normal intracell HO

- Intercell intrazone HO: large --> large:
  normal intercell inter BSS or intra BSS

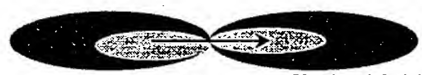
- Intercell interzone HO: small --> large
  1_ EXP1 > 0
  2_ PBGT (msTxPwrMax, bizonePowerOffset)
  3_ EXP2 > 0



- Intercell interzone HO: large --> small
  1_ EXP1 > 0
  2_ PBGT(msTxPwrMax)
  3_ EXP2 > 0
  4_ EXP3 (bizonePowerOffset(n)) > 0



- Intercell intrazone HO: small --> small
  1_ EXP1 > 0
  2_ PBGT (msTxPwrMax, bizonePowerOffset)
  3_ EXP2 > 0
  4_ EXP3 (bizonePowerOffset(n)) > 0



Concentric Cell: Direct TCH allocations

Parameters

bsTxPwrMax:
- max theorical level of BTS transmission power in a cell
- powerControl object
- [2, 51]dB -> D: Pr max=43dB/ H2D: Pr max=40dB/ H4D: Pr max=37dB

Attenuation:
- attenuation due to coupling system loss
- transceiverZone object
- [0dB, 14dB], recommended: null ← Use DLU attenuation instead of Attenuation parameter on MMI

zone Tx power max reduction:
- attenuation applied to transceiver of small zone
- btsSiteManager object
- [0dB: large] -> recommended: D (S666)=0dB/ H2D (S888)=0dB
- [1dB, 55dB: small] -> recommended: H2D (S666)=3dB/ H4D(S888)=4dB

concentric cell:
- cell type
- bts object, class 2
- [monozone, concentric, dualband, dualcoupling], recommended= dualcoupling

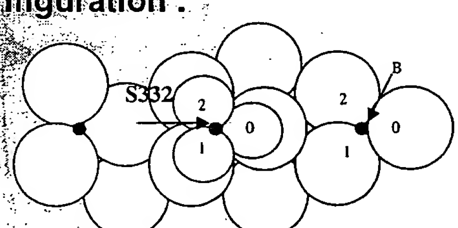
Concentric Cell: Freq. reuse on both zones

- The other enhancement in Concentric Cells feature deals with the modification of concentric cells for allowing frequency reuse on both zones.
- Previously when two zones were created for concentric cells, each one used its own frequencies since the frequency reuse pattern was different.
- It allows to define one frequency set per cell and so to profit of the NORTEL frequency reuse strategy (1*1 and 1*3).
- This feature allows to increase the hopping gain by using only one set of frequencies per cell.
- For the operator, the time required for frequency planning is reduced.

Concentric Cell Improvements: VO results

- Tests Configuration

The tests have been performed on one S332 site (S8000). All the neighboring cells were configured as normal cells and were attached to the same BSC. The following figure shows the concentric configuration :



- Only 1 TDMA in the small zone for each cell.
- Uplink and Dowlink power control activated for TCH.
- Uplink and Dowlink DTX activated.

Concentric Cell Improvements: VO results

- How are the engineering parameters defined for VO tests
  - concentAlgoExtRxLev :

    This parameter allows to define the size (or coverage) of the small zone (SZ). For example SZ=90% means that 90% of the mobiles in the cell have a DL RxLev (according to the mobile repartition versus RxLev corrected at Pmax) higher that the threshold choosen for concentAlgoExtRxLev.
  - biZonePowerOffset(n) :

    concentAlgoExtRxLev ≤ rxLevMinCell(n) + biZonePowerOffset(n) This inequality determines biZonePowerOffset(n) and avoids inter-zone ping-pong handover after incoming HO in small zone.
  - concentAlgoIntRxLev, biZonePowerOffset :

    concentAlgoIntRxLev = concentAlgoExtRxLev - ΔP- Hysteresis

    biZonePowerOffset = ΔP

    ΔP = difference of BS power between large zone and small zone.

Concentric Cell Improvements: VO results

- Tests Schedule & Configurations

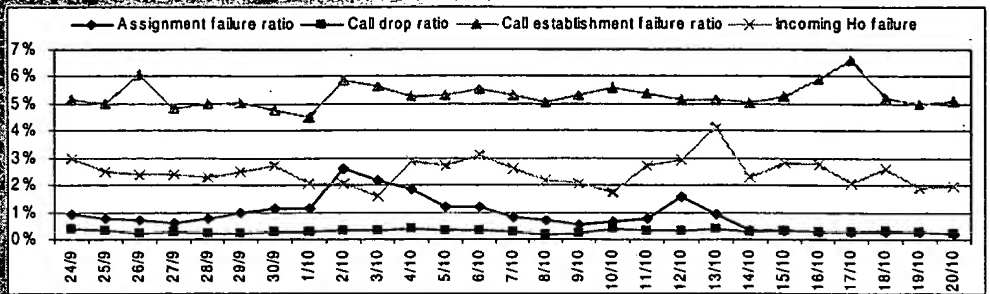
Date	29-sept	30-sept	1-oct	2-oct	3-oct	4-oct	5-oct	6-oct	7-oct	8-oct	9-oct
Configuration number	1.0	1.1	1.1	1.1	1.1	1.1	1.1	2	3	4	4
Parameters	Default	Default	Default	Default	Default	Default	Default	DP=3dB	DP=3dB	DP=3dB	DP=3dB
								SZ=90%	SZ=75%	SZ=50%	SZ=50%
Frequency Hopping	No	No	No	No	No	No	No	No	No	No	No
ZoneTxPwrMaxReduction(small)	0	0	0	0	0	0	0	3	3	3	3
ConcentAlgoExtRxLev	-101	-101	-101	-101	-101	-101	-101	-92	-83	-75	-75
ConcentAlgoIntRxLev	-105	-105	-105	-105	-105	-105	-105	-99	-90	-82	-82
biZonePowerOffset (local cell)	0	0	0	0	0	0	0	3	3	3	3
biZonePowerOffset (adjacent cell)	[redacted]	0	0	0	0	0	0	1	10	18	18

Date	10-oct	11-oct	12-oct	13-oct	14-oct	15-oct	16-oct	17-oct	18-oct	19-oct	20-oct
Configuration number	4	4	5	6	7	8	8	8	9	10	11
Parameters	DP=3dB	DP=3dB	DP = 4dB	DP=8dB	Default	DP=3dB	DP=3dB	DP=3dB	DP=3dB	DP = 4dB	DP=8dB
	SZ=50%	SZ=50%	SZ=90%	SZ=75%		SZ=90%	SZ=90%	SZ=90%	SZ=75%	SZ=90%	SZ=75%
Frequency Hopping	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ZoneTxPwrMaxReduction(small)	3	3	4	8	0	3	3	3	3	4	8
ConcentAlgoExtRxLev	-75	-75	-92	-83	-101	-92	-92	-92	-83	-92	-83
ConcentAlgoIntRxLev	-82	-82	-100	-95	-105	-99	-99	-99	-90	-100	-95
biZonePowerOffset (local cell)	3	3	4	8	0	3	3	3	3	4	8
biZonePowerOffset (adjacent cell)	18	18	1	10	0	1	1	1	10	1	10

- DP = Difference of BS power between the large zone and the small zone
- SZ = coverage of the small zone in terms of mobile traffic

Concentric Cell Improvements: VO results

- Quality of Service (1)

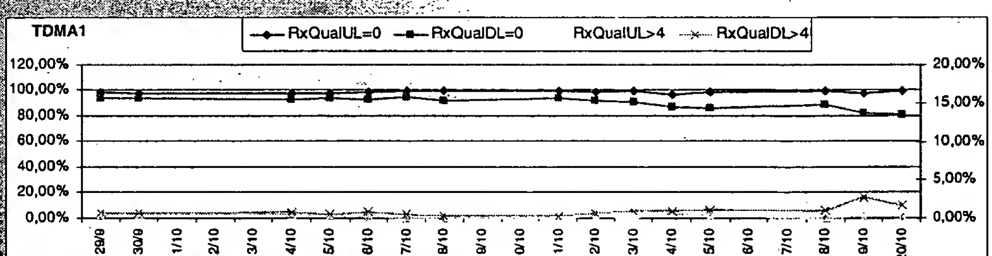


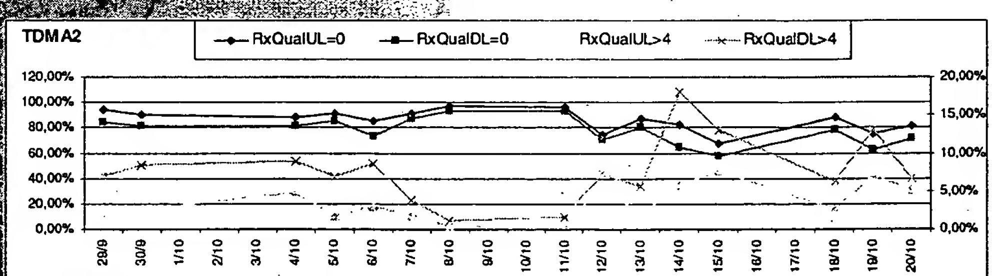
– Non Regression in terms of quality of service with or without Frequency Hopping activated

– The peaks mainly correspond to week ends calls, especially for the assignment failure and the call establishment failure (See 26/09, 02/10, 03/10, 16/10, 17/10...).
The high values for Incoming HO failure the 13th and Assignment failure the 12/10 are certainly exceptions.

Concentric Cell Improvements: VO results

- Quality of Service (2)





Concentric Cell Improvements: VO results

- Quality of Service (3)

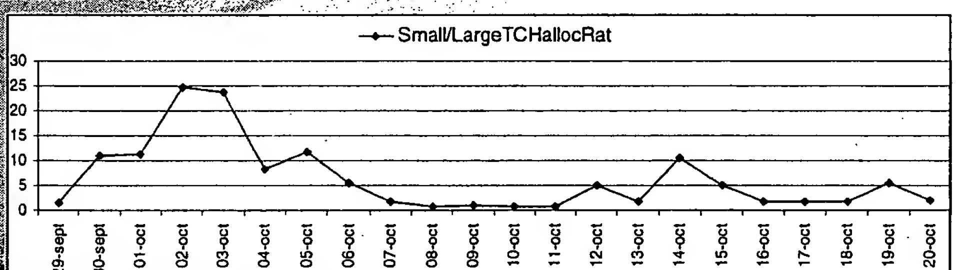
  – No Regression in terms of quality of service in the small zone (TDMA1)

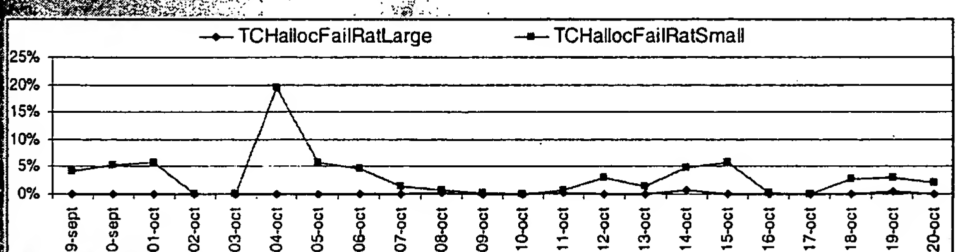
  – Slight degradation of the RxQual from 14th with activation of SFH. This degradation is due to an important frequency load per cell for the activation of SFH (40% : 5 frequencies for 2 TDMAs), but it does not induce any degradation in terms of QoS and voice quality.

  – When the small zone (TDMA1) is large, only the mobiles with poor RxLev stay in the large zone (TDMA2), inducing a degradation of the RxQual average in this zone.
  In such configurations with large small zone (default configurations for example) the number of mobiles in the outer zone is very low, and so their influence is not significant

Concentric Cell Improvements: VO results

- TCH Blocking (1)



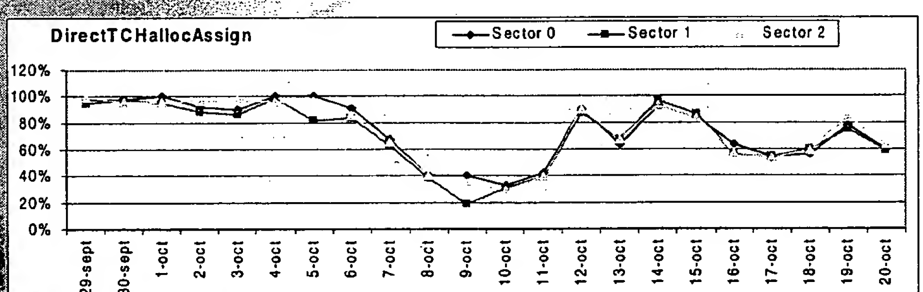


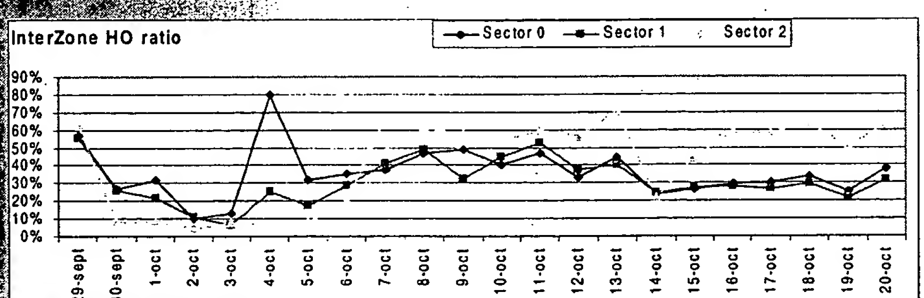
Concentric Cell Improvements: VO results

- TCH Blocking (2)
  - No TCH blocking in the large zone, only TCH blocking is noted in the small zone.
  - Larger is the small zone, higher is the traffic in this zone with the same number of TCH, inducing an increasing of the TCH allocation failure in this zone (default configuration).
  - A small inner on outer TCH allocation ratio corresponds to a small inner zone (9th of October) or a high value of bizonepoweroffset for the adjacent cell HO object (29th of September).
  - The TCH allocation failure the 4th of October corresponds to unitary tests with TCHs locked in the small zone.
  - A SRD is opened to create a cell counter which does not include the TCH allocation failure in the small zone, but this problem is not critical because when the mobile does not find a TCH in the small zone, TCHs are available in the large zone.

Concentric Cell Improvements: VO results

- Concentric Cell Improvements (1)





Concentric Cell Improvements: VO results

- Concentric Cell Improvements (2)
  - The first graph shows the ratio of direct TCH allocation in the small zone . Higher is the coverage of the small zone, higher is this ratio. Tuning the size of the small zone can allow to minimize the risk of saturation for the large zone.
  - The second graph gives the inter-zone handover ratio versus Assignment Complete. This graph allows to quantify the number of inter-zone handovers according to the configuration.
  - 63dB for bizonepoweroffset of the adjacent Cell Handover object (See 29th of September) inhibits the feature, and so the mobile must go to the large zone before going to the small increasing the number of interzone handovers required.
  - With small inner zone configurations (See 9th, 10th & 11th of October), as explained before, the mobile coming from a neighbouring cell must go in the outer zone in first before going in the inner zone (if radio criteria are met), increasing the number of interzone handovers required.

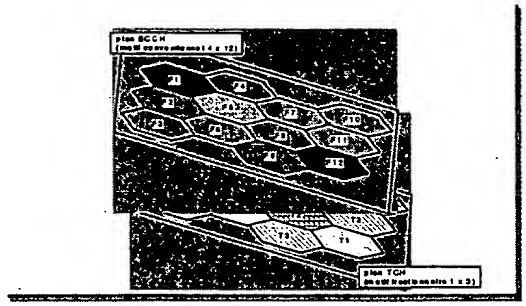
Concentric Cell Improvements: VO results

Conclusions

- QoS stable during the tests.
- The risk of saturating the large zone has been reduced by direct TCH allocation.
- The number of interzone handovers and so the load of the BSC can be reduced by a good tuning of the small zone size and the parameter bizonepoweroffset for the adjacent Cell Handover object.
- The frequency hopping with frequency reuse in both zone has been successfully tested in terms of non regression in the concentric cells. The quality can be improved by decreasing the load frequency (using more frequencies for 2 TDMAs)

Automatic Cell Tiering

- Aims at reducing interference in a fractional reuse network by allocating communications with poor C/I to the non hopping frequencies (BCCH, non hopping TCH)* while communications with good C/I are carried on the TCH
  - An IntraCell HO is performed to ensure that the communication is carried on the correct frequency
  - The HO decision is done during the call and is based on the estimation of the Potential Worst downlink C/I called PWCI where:



$$\boxed{PWCI = (RxLevDL + BSAtt) - (\Sigma\ RxLevNcell(i) + \Sigma\ RxLevNcell(j)\ - ADC)}$$

Where: BSAtt (dBm) = BTS Attenuation

RxLevNcell(i) (dBm) = DL signal strength(Measured by MS) of a cell using same TCH frequency set as current cell

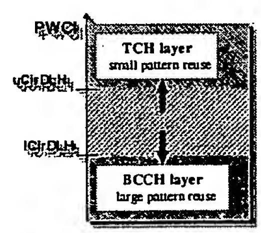
RxLevNcell(j) (dBm) = DL signal strength(Measured by MS) of a cell using different TCH frequency set as current cell

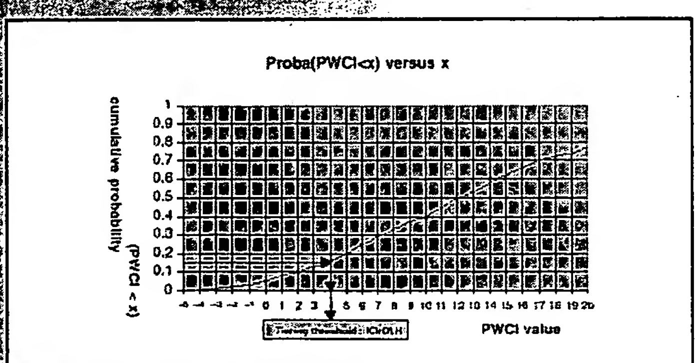
ADC = First Adjacent Channel Protector Factor (fixed in BTS software at 18 dB)

Automatic Cell Tiering

- PWCI measurements are averaged with a PWCI averaging window *pwciHreqave* and allows to trace the PWCI distribution curve for defining low and high HO decision thresholds called *lCirDLH* and *uCirDLH* (these thresholds are computed by the BCF)

  uCirDLH = lCirDLH + hoMarginTiering





Automatic Cell Tiering: Context

- Fractional Re-use pattern
  - 4*12 BCCH pattern
  - 1*1 or 1*3 TCH pattern
- Activation of L1M V2
- Upgrade necessary to activate cell tiering:
  - OMC V12.3
  - BSC V12.3
  - BTS V12.3

⇒ cell tiering allows a significant increase in the fractional load

Automatic Cell Tiering: Principle

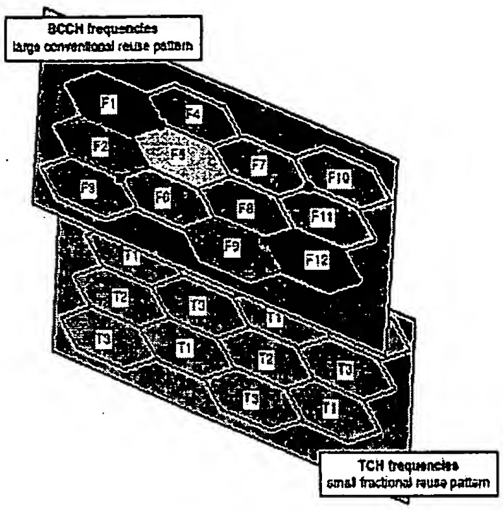
- **Today, TCH resource allocation strategy favours low-interfered channels, and then hopping TS**

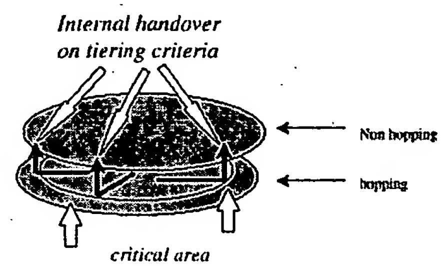
this does not optimize the «worst case» situations, in terms of interference, which determine the acceptable grade of service, and in particular the maximum load which can be accepted on a network when fractional reuse is applied.

«Tiering» is a technique to organize the TCH allocation to minimize the worst cases.

- Optimised radio resources allocation algorithm
- Automated parameter setting
- Permanent auto adaptive algorithm

Automatic Cell Tiering: Principle





- **BCCH- TDMA is always at least in 4x12 reuse**
- **other TDMAs are in a much closer reuse**

BCCH-TDMA is much better protected against C/ I than the other TDMAs

calls which are potentially generating interference or subject to interference should be allocated a channel on the BCCH- TDMA.

Automatic Cell Tiering

Principles

- For each communication in each cell, measurement reports are sent by the MS to the BTS that computes them into PWCI. They depend on the RxLevDL of the serving cell, on the BCCH neighbouring cells (RxLevNCell(n)) and on the type of the neighboring cell (adjacent or co-channel interferer)
- The PWCI is monitored by the BTS for all the calls in progress in the cell
- PWCI measurements allow to set 2 HO decision thresholds: *lCirDLH* and *uCirDLH*
- *lCirDLH* is computed through the averaged PWCI distribution curve and thanks to a threshold that equals *number of non hopping voice TCH / number of total voice TCH*
- *uCirDLH = lCirDLH + hoMarginTiering*
- if PWCI > *uCirDLH* => intracell HO with tiering cause is done from non-hopping pattern reuse to hopping reuse pattern (BCCH layer to TCH layer)
- if PWCI < *lCirDLH* => intracell HO with tiering cause from hopping reuse pattern to non-hopping reuse pattern (TCH layer to BCCH layer)

Drawbacks

- The cell tiering configuration relies on a correct definition of interferers for each cell (through *interfererType*)
- There is a risk of ping-pong (see further)
- This feature is based on values of PWCI that depends of the traffic that is not taken into account (see further)

Automatic Cell Tiering

Risk of ping-pong

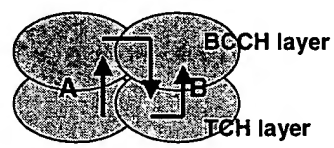
• In this example : The MS in the overlapping zone is moving from A to B. Since it is in the overlapping zone, the C/I decreases and it activates the tiering. The MS goes to a TCH on cell B through an intercell HO (because of the resource allocator in the BSC that will allocate a non interfered hopping TCH preferably). Then, the MS goes onto BCCH since the C/I in the overlapping in cell B is not good

• => too many useless HO

→ Tiering HO at TCH allocation

→ Intercell HO

→ Defensive tiering ping-pong HO done to worsst C/I



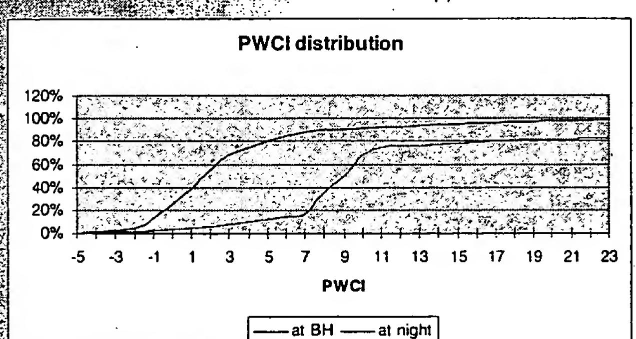
Automatic Cell Tiering

Miscellaneous

• The PWCI distribution is different at night and at the Busy Hour. Therefore, at night the information from the PWCI is not relevant anymore. For instance, if 15% is the threshold that helps determining lCirDLH, at the BH the C/I is around -1 whereas it is around 7 at night. Is it really useful to activate the cell tiering once the C/I is around correct values such as 7? It could be useful to set a new parameter (such as *Tiering_necessary*) beyond which there is no tiering : for instance, if x% of PWCI is above *Tiering_necessary*, then do not use the tiering feature

• One has to be careful that if (groups of) frequencies are changed, the *InterfererType* value has to be redatafilled in the AdjacentHandOver object

• In a dualcell, this feature is only applicable within the large zone (from LZ_TCH to LZ_BCCH) since those calls will the most interfered ones (cell border and overlap)



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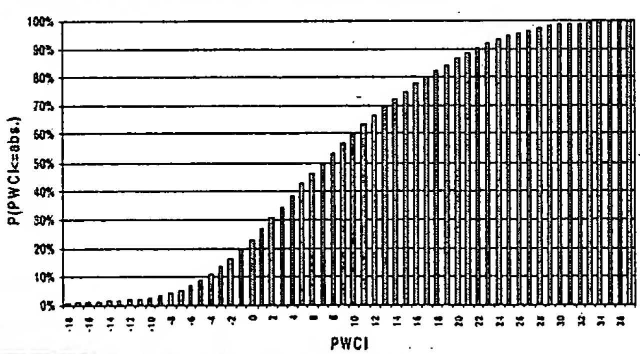
Automatic Cell Tiering: Algorithm

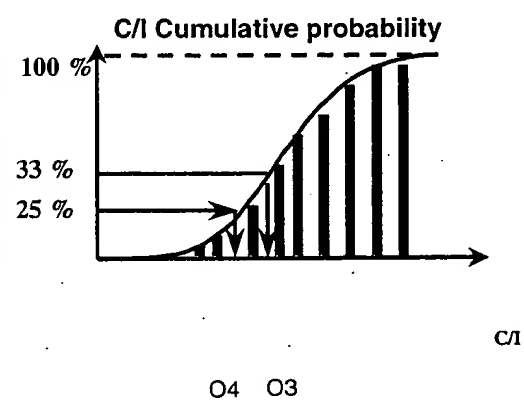
- **Algorithm**
  - if the TCH is hopping, and C/ I falls below a threshold Ci l , an intra-cell HO is triggered to a non- hopping TCH if any available
  - if the TCH is non hopping, and C/ I becomes better than a threshold Ci h , an intra- cell HO is triggered to an hopping TCH if any available
  - in both cases, if no TCH is available, no HO should be made : a new attempt should occur after some time
- **Definition of Potential Worst C/I (PWCI)**
  - RxLev measured by the MS on current cell and neighbour cells
  - each RxLev is weighted depending whether TCH frequencies of the neighbour cell are cochannel or adjacent with current cell frequencies

$$\boxed{PWCI = RXLEV(current) / \text{sum of } (k^* RXLEV(neighbour)) \text{ in Watts}}$$

Automatic Cell Tiering: PWCI calculation

- The cumulative distribution of PWCI is calculated over the cell
- The tiering threshold is then self tuned by the cell based on the cumulative distribution of PWCI and on the ratio of non hopping resources over total resources





- HO performed from hopping to non-hopping if PWCI < *lCirDLH*
- HO performed from non-hopping to hopping if PWCI > *uCirDLH*

Automatic Cell Tiering

- New Parameters

Parameter	Description	Object	Range	Class
measProcAlgorithm	choice of L1M software	bts	[V1, V2]]	2
intraCell	intraCell HO on quality and tiering causes	handOverControl	[none, intracell, tiering]]	3
hoMarginTiering	hysterisis between uCirDLH and lCirDLH	handOverControl	[0, 63] dB	3
pwciHreqave	Number of measurement reports for PWCI averaging	handOverControl	[1,16]	3
numberOfPWCISamples	Minimum number of PWCI samples gathered by the BCF to compute reliable distribution	handOverControl	[0,60]	3
selfTuningObs	Whether PWCI samples are sent on the ABIS I/F	handOverControl	[0,1]	3
NbLargeReuseDataChannels	Mean number of logical channels belonging to the large frequency reuse pattern and used at the same time fo rdata communications (14.4 kbps)	handOverControl	[-16,16]	3
interferType	indicates for each neighbor if it generates cochannel or adjacent channel interference to current cell	adjacentCellhandOverControl	[0,1,2]	3

Automatic Cell Tiering: Parameters

object	default value
bts	
measProcAlgorithm	V1
nbLargeReuseDataChannels	0
adjacentCellHO	
interfererType	'not applicable'
handOverControl	
intracell	previous value
hoMarginTiering	4 dB
hreqAvePwCI	4
nbPwCISamples	20
selfTuningObs	0

Automatic Cell Tiering

Counters

- hoRequiredTchTieringLargeToSmallPattern (C1138/15) : number of required HO in the cell
- hoRequiredTchTieringSmallToLargePattern (C1138/16) : number of required HO in the cell
- hoSuccessTieringTchLargeToSmallPattern (C1802/0) : number of tiering HO performed on the air I/F
- hoSuccessTieringTchSmallToLargePattern (C1802/1) : number of tiering HO performed on the air I/F
- hoFailureTieringTchNorrLargetoSmallPattern (C1801/0) : number of tiering HO failures due to lack of radio resources
- hoFailureTieringTchNorrSmallToLargePattern (C1801/1) : number of tiering HO failures due to lack of radio resources

Automatic Cell Tiering: Capacity Gain

frequency load = # of hoping / # of hoping freq

- **Around 200% capacity gain compared to 4x12**
  - EX : 4.8 MHz

Frequency load up to 16.7% (1x1) or 50% (1x3)

S222

Frequency load up to 33 % (1x1)

S333

S555

1x1 / 1x3

Cell Tiering

+99%

+230 %

- **Next step**

  synchronisation to allow to a better control of interferences

ANNEX (1)

HO cause / connection state request type	eligibility criteria
Power Budget	powerBudgetInterCell(n) = true EXP1 (n) > 0 EXP2 PBGT (n) > 0 EXP2 bis (n) > 0 deleteCounter(n) < cellDeletionCount(n)
Traffic	trafficInterCell(n) = true EXP1 (n) > 0 EXP2 Traffic (n) > 0 EXP2 bis (n) > 0
UL / DL signal quality	ul / dl QualityInterCell(n) = true EXP1 (n) > 0 EXP2 Quality (n) > 0
UL / DL signal strength	ul / dl SignalStrengthInterCell(n) = true EXP1 > 0 EXP2 Strength (n) > 0
Distance	msBtsDistanceInterCell(n) = true EXP1 > 0 EXP2 Distance (n) > 0
Capture	captureInterCell(n) = true EXP1Capture (n) > 0
Forced HO	interBtsForcedHO(n) = true EXP1 Forced HO (n) > 0
Directed retry	interBsDirectedRetry(n) = true EXP1 Directed retry (n) > 0

ANNEX (2)

Expression	Description
EXP1(n)	RxLevNCell(n) $_{ave}$ - [rxLevMinCell(n) + Max(0, msTxPwrMaxCell(n) - msTxPwrCapability(n))]
EXP1 Capture (n)	RxLevNCell(n) $_{ave}$ - rxLevMinCell(n)
EXP1 Directed retry (n)	RxLevNCell(n) $_{ave}$ - [directedRetryAlgo(n)) + Max(0, msTxPwrMaxCell(n) - msTxPwrCapability(n))]
EXP1 Forced HO (n)	RxLevNCell(n) $_{ave}$ - [forcedHandoverAlgo(n) + Max(0, msTxPwrMaxCell(n) - msTxPwrCapability(n))]
EXP2 PBGT(n)	Pbgt(n) - hoMargin(n)
EXP2 Traffic (n)	Pbgt(n) - [hoMargin(n) - hoMarginTrafficOffset(n)]
EXP2 Quality (n)	Pbgt(n) - hoMarginRxQual(n)
EXP2 Strength (n)	Pbgt(n) - hoMarginRxLev(n)
EXP2 Distance (n)	Pbgt(n) - hoMarginDist(n)
EXP2bis(n)	rxLevDLPB(n) - RxLevDL $_{ave}$